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ANALYSIS OF [illegible] PATIENT TRAY DELIVERY CONCEPTS

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A methodology for, and the results of, a systematic evaluation and comparison of the alternatives for replacement or upgrading of tray delivery service in Army Medical Treatment Facilities is provided. The methodology determines the effectiveness of four viable alternatives in terms of performance, labor requirements, compatibility with existing facilities, equipment characteristics, and cost; and compares the results with the conventional hot/cold carts currently in use. The results of the analysis show that the insulated tray concept for patient tray delivery offers the highest level of effectiveness for the systems evaluation through improved labor, equipment, and compatibility characteristics.

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Preface

This report documents the results of a system effectiveness analysis of four alternative patient tray delivery systems for use in Army Medical Treatment Facilities as compared to the hot/cold carts currently in use. The major objective was to evaluate the alternative patient tray subsystem that would provide high quality foods, would require less food service personnel, and which could be introduced into existing facilities without requiring significant changes in the food service system. The end result of this analysis will provide recommendations for replacement of the current system and will also support the analysis of the total hospital food service system by determining the salient features of tray delivery relative to the overall system effectiveness.

This analysis represents the completion of the initial task in response to the DoD Food RDT&Eng Program, Project No. 1L162724AH99AD014, "Systems Analysis of Army Hospital Food Service Operations" under USA 8–4.

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INTRODUCTION

A systems analysis of the food service in Army Medical Treatment Facilities (MTF) is being conducted to determine the most cost-effective method for serving highly acceptable, nutritionally adequate meals to patients and other authorized personnel. The purpose of this study is to evaluate state-of-the-art concepts and to provide the Office of The Surgeon General (OTSG) with the best design options for use in the construction of new facilities, or in the renovation of older facilities. This work is being accomplished under Military Service Requirement USA 8–4, "Systems Analysis of Fixed Army Hospital Food Service Operations."

An immediate requirement is a preliminary analysis of the patient tray delivery subsystem. This report provides a methodology for, and the results of, a systematic evaluation and comparison of the alternatives for replacement or upgrading of tray delivery service in existing facilities.

Objectives

The objectives of this analysis are to:

(1) Assess the critical performance characteristics in the selection of a hospital patient tray delivery system.

(2) Develop a systems effectiveness model to evaluate the alternatives which may be used to replace the current delivery system in existing facilities.

(3) Analyze the alternative systems to formulate conclusions and recommendations which will aid in the selection of the preferred alternative.

Statement of Problem

Different hospital food service concepts utilize a variety of patient tray delivery options in different functional combinations, as shown in Figure 1. The particular choice of a delivery method must be determined by the operational and physical constraints of the food service system in which it must operate. In the case of existing Army Medical Treatment Facilities, the conventional food production system with single tray assembly is the current mode of operation. Although any of the patient tray delivery alternatives depicted could possibly be employed in these facilities, some of them would require considerable additional equipment and substantial changes in tray assembly procedures, production methods, workforce levels and operating costs. Thus, the general methodology developed for evaluation and comparison of the patient tray delivery systems considers all such factors relative to their impact on the effectiveness of the total food service system.

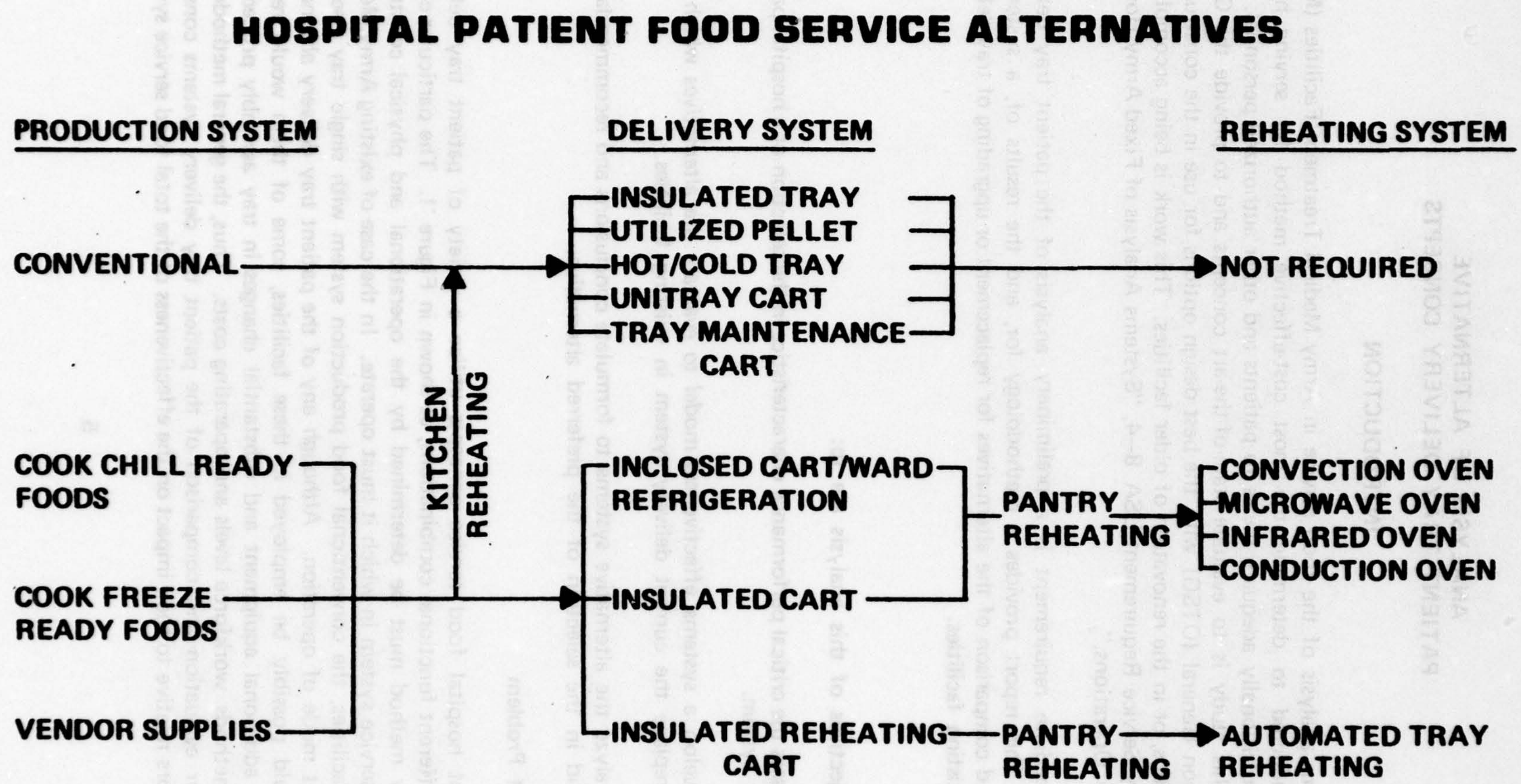
HOSPITAL PATIENT FOOD SERVICE ALTERNATIVES
PRODUCTION SYSTEM
DELIVERY SYSTEM
REHEATING SYSTEM
CONVENTIONAL
INSULATED TRAY
UTILIZED PELLET
HOT/COLD TRAY
UNITRAY CART
TRAY MAINTENANCE CART
NOT REQUIRED
KITCHEN REHEATING
COOK CHILL READY FOODS
COOK FREEZE READY FOODS
VENDOR SUPPLIES
INCLOSED CART/WARD REFRIGERATION
INSULATED CART
INSULATED REHEATING CART
PANTRY REHEATING
PANTRY REHEATING
CONVECTION OVEN
MICROWAVE OVEN
INFRARED OVEN
CONDUCTION OVEN
AUTOMATED TRAY REHEATING

Figure 1

DESCRIPTION OF ALTERNATIVES

Conventional Systems

A conventional food production system is defined as one which utilizes a low percentage of prepared food items and relies on the preparation of most menu items from their basic ingredients with preparation, assembly, and finishing done in the kitchen, Typically, patient tray delivery involves some form of temperature maintenance system (e.g., hot-cold system) designed to maintain proper food temperature of the meal from the time it leaves the kitchen until it reaches the patient. The principal advantage of temperature maintenance systems is their basic simplicity. Thus, most complex operations including plating and portion control, are carried out in the kitchen under close supervision, and pantries requiring skilled personnel on the patient floors are not needed. Their greatest disadvantages are the inability to maintain quality, nutrient values, and proper temperature for extended periods of time, inability to handle late trays effectively, and the requirement for hot food preparation to be keyed to tray assembly, which results in less efficient utilization of labor.

Temperature Maintenance Systems

Alternative M–1 is the foamed in-place insulated tray system which is available from several different sources. The tray holds the hot and cold food items in individual molded compartments in an insulated tray with an insulated fitted cover. The complete meal, hot and cold items and beverages, is assembled on a single tray. Proper temperatures are *maintained* by the insulating properties of the tray system for a period long enough to allow delivery and service of the meal (*i.e.*, at least 30 minutes). The meals are delivered to the ward either stacked or individually on a suspended tray cart which carries up to forty trays.

a. **Advantages:**

(1) Simple, light weight transportation equipment — no special carts.

(2) No complex components to repair, maintain, or replace.

(3) Maintenance of hot and cold zones without external heat or refrigeration.

(4) Availability of lease or buy alternatives

(5) Flexibility of using china or disposable dinnerware.

b. **Disadvantages:**

(1) Holding time is limited to about 30 minutes.

(2) Some foods take on a steamed appearance.

(3) Adverse reaction by some patients to compartmentalized tray.

(4) Not conducive to large or spread-out facilities with resultant long delivery times.

Alternative M–2 is the unitized pellet system. Hot food temperatures are maintained using a one-piece base containing an alloy pellet – not the older separate base and pellet arrangement. The meal is assembled with all the hot items on a plate placed on this pellet, which has been thoroughly preheated, and then covered with a stainless steel or plastic lid to retain heat and moisture. Up to thirty trays are delivered to the floor in an uninsulated cart. For best results, this type of system requires thorough preheating of serving plates and unitized base; simultaneous loading of hot and cold foods and beverages, and rapid delivery to prevent warming of the cold food and cooling of the hot food.

a. **Advantages:**

(1) No special plates are required – any standard disposable or china can be used.

(2) No special insulated delivery cart is required.

(3) Flexibility of using china or disposable dinnerware.

b. **Disadvantages:**

(1) No provision for maintenance of cold items.

(2) Holding time is limited to approximately 45 minutes.

(3) Possible burn hazard to patient or attendant from hot base.

(4) Additional equipment and serviceware to be maintained.

(5) Additional electrical service required.

(6) Not conducive to large or spread out facilities.

Alternative M–3 is the presently used system utilizing a tray cart with electrically heated and refrigerated compartments to maintain proper food temperatures. These tray carts are quite heavy (approximately 1300 pounds loaded) and are often motorized for use in facilities with ramps. Loading of this type of cart, once it has been preheated, is carried out in several steps. The order of these steps varies within different facilities, but must include: (1) bulk loading of coffee, soups, water, and other beverages; (2) cold loading of all trays; and (3) hot loading. In single-tray assembly, the cold and hot items are loaded simultaneously. Otherwise, in split tray assembly operations, cold loading usually precedes hot loading with the cart being connected to an electrical outlet until hot loading begins. On the floor a food service worker reassembles the tray from the separate hot and cold compartments and the beverage dispensers.

a. **Advantages:**

(1) Each food item can be stored in proper environment to control temperature for longer times than most other systems – more conducive to larger or spread out facilities.

(2) Frozen items (i.e., ice cream, sherbert) can be stored in a freezer compartment.

(3) No special plates are required.

b. **Disadvantages:**

(1) Mechanically complex system.

(2) Heavy cart often required to be motorized.

(3) Needs more cart parking space than other systems.

(4) Requires additional electrical outlets.

(5) Requires reassembly and matching of items on patient trays before serving.

(6) Hot items may overcook if held for too long a time.

(7) Requires more time for cleaning and maintenance than most other systems.

Alternative M–4 is the single-tray, hot-cold cart or the unitray concept. This type system is very similar to the standard hot-cold system. The meal is assembled on one tray with hot and cold items on separate ends of the same tray. The trays, however, are slotted to isolate either end of the tray into a hot or a cold compartment when

placed in the cart. This alleviates the problem of tray reassembly on the ward. The advantages and disadvantages are the same as for system M–3 just described with the exception of tray reassembly having been eliminated.

Alternative M–5 is the tray heater system, which utilizes the manufacturer's line of disposable tableware. The hot and cold foods are plated in the usual manner at serving temperatures. Integral resistance heaters are built in the tray at the dinner plate and bowl positions to maintain the temperatures of the foods at these locations. The tray heaters are activated when placed in the cart. Heating of individual food items in these positions on each tray are "programmed" via a push-button control panel designed into the cart. On completion of loading of the cart, a locking device can be activated to preclude accidental resetting of the buttons. As a tray is removed from the cart, the heaters are automatically disconnected and rapidly return to room temperature for obvious handling and safety reasons. The temperatures of cold foods, in other than the indicated positions, are not affected by the tray heaters. Hot beverages are delivered in insulated containers.

a. **Advantages:**

(1) Heat to plate and/or bowl is controllable.

(2) Insulated drawer for frozen items.

(3) The heating source provided allows for longer holding times thus the system is better suited for large, spread out facilities.

b. **Disadvantages:**

(1) Very complex system with possible maintenance and repair problems.

(2) Necessitates expensive disposables.

(3) More expensive system to buy or operate.

(4) With no refrigeration, cold items may get warm if held too long.

(5) Heavy cart may require motor.

(6) Requires overnight recharging of batteries for use the next day.

Reheating Systems

A second set of alternatives available for hospitals operates with chilled or frozen foods--the so-called ready foods. These involve cold delivery and are not considered as

feasible solutions since they are not compatible with the existing Army Medical Treatment Facilities food service system design and would require major operational and equipment changes in functional areas outside of the patient tray service. However, the benefits of this type patient tray delivery system, which are particularly apparent in larger facilities, make a discussion of these systems important. When operating this kind of system, the obvious advantages are a capability to provide hot meals to patients at any time, efficient scheduling of kitchen personnel since preplating and tray assembly need not immediately precede delivery, and the reduction in space required for the cart parking and tray assembly areas. In addition, these systems are designed to be used with a production cycle which provides savings in operating costs through efficiencies of scale (i.e., lower food costs by bulk purchasing, and more efficient use of equipment and personnel in large-scale batch-production), and improved manpower utilization by use of a standard 40-hour work schedule for a larger number of the food service staff. The disadvantages include the high initial expense of these systems, requirements for large refrigerated holding areas on the ward and in the kitchen, and requirements for more labor operating pantry equipment on the ward galleys.

In summary, these systems are capital intensive, but can produce savings by reducing labor in other areas beyond just the food preparation. However, it should be realized that in all these systems, excepting the automated tray reheating alternative, man-hour requirements on the wards are often much greater than that currently needed with the hot/cold carts.

The first alternative requires a special ward galley consisting of a mobile insulated cart, a roll-in refrigerator, and a convection oven mounted above the refrigerator. In the kitchen, the chilled food is loaded on the patient trays which are in turn loaded into the mobile base cabinet. The plates that are to be served hot are covered with plastic wrap and placed in a rack on top of the mobile base cabinet. This mobile unit is transported to the floor galley where the rack is removed and inserted into a small convection oven, and the mobile cart is rolled into the holding refrigerator. After the items are reheated, the trays are reassembled, adding beverages, soups, and other items. Late trays, meals that are difficult to reheat in convection ovens, or meals that must be held are usually handled in microwave ovens installed at each floor galley.

a. **Advantages:**

(1) No special trays, plates, covers, etc. to purchase.

(2) Produces large numbers of meals at once.

(3) Does not require precise plating techniques of some other reheating systems.

b. **Disadvantages:**

(1) Mass reheating of various entrees does not offer thermal selectivity and overheating can result.

(2) Late trays must be microwaved.

(3) Requires much reassembly.

Another alternative uses a microwave oven to reheat the meals. The trays are assembled in the kitchen and brought to the floor galley in an insulated cart which is then held in a roll-in refrigerator. As each meal is needed, the hot food is reheated by microwave while beverages and other items are assembled on the tray. After reheating, the hot items are added to the tray for patient delivery.

Also available is a modified microwave oven that allows reheating of an entire tray without disassembly and reassembly through the use of heat shields which match a special tray design. This is a very high-cost leased system.

a. **Advantages:**

(1) Each meal is individually reheated immediately before serving.

(2) Late and delayed trays are easily accommodated.

(3) No special dinnerware is required.

b. **Disadvantages:**

(1) Some foods cannot be successfully reheated by microwave.

(2) Care must be taken in plating food to insure even reheating.

(3) Requires considerable handling in the ward galley.

The third alternative is very similar to the convection oven system but, instead of using plastic covered plates and an oven insert, the hot food is placed in stainless steel containers on a special rack which is rolled into an infrared oven for reheating.

a. **Advantages:**

(1) Turns out a large number of meals at one time.

(2) Does not require precise plating techniques of some other systems.

(3) Late and delayed trays are easily accommodated.

b. **Disadvantages:**

(1) Requires purchase and maintenance of additional covers, bases, etc.

(2) Mass reheating of various entrees can result in overheating.

(3) No simple way to handle late trays.

(4) Requires considerable handling in the ward galley.

The automated tray reheating method is the most technologically advanced system. It consists of a patient cart that reheats the hot foods within a refrigerated environment. The cart is an insulated cabinet designed to be connected to refrigeration units that are permanently installed in the kitchen and on patient floors. No refrigeration equipment is installed on the cart.

Patient trays are completely assembled in the kitchen with the exception of hot beverages and frozen desserts. The tray is designed with openings to accent modular tableware. The center tray opening corresponds with the location of "hot plates" on each shelf of the cart, so that when it is placed in the cart, dishes in the center of the tray are resting on the "hot plate." All food being heated must be covered.

Each shelf has five center hot plates with four temperature settings, or the hot plate can be turned off completely. A standard temperature setting is used for each meal, but may be changed in the kitchen or ward.

Standard procedure is to have a Master Entry Console (MEC) located at the end of the tray assembly line which is connected to a memory unit. Tray number and heat level changes are entered via the MEC as they vary from the standard program. A print-out of the tray number and heat settings is produced and is attached to the cart for future reference and changes. The temperature settings are also held in a memory unit which is attached to the cart. Loaded carts can be transported to the patient floors hours before serving time and connected to a refrigeration unit located in miniature floor galleys. Each cart and refrigerator is then controlled by an electronic command device, using the data stored in the memory unit. It also performs load sharing of available power; automatically turns on the reheating cycle at specific predetermined starting times; and has the capability of changing the temperature settings of the heat surfaces.

a. **Advantages:**

(1) Allows completely centralized tray assembly.

(2) A large number of trays can be reheated together with individual temperature control.

(3) Slow reheating provides high quality.

(4) Little labor required on ward.

(5) Can handle wide menu range.

(6) Precise plating is not required.

b. Disadvantages:

(1) Requires considerable floor space in kitchen and on patient ward.

(2) Very expensive.

(3) Requires special dishware.

(4) With slow reheating, late trays require more time (i.e., over 30 minutes) to heat than with other methods.

(5) Complex system, as yet not fully tested, that can be expected to be difficult to operate and maintain.

(6) Partially compartmentalized tray and may cause some adverse patient reaction.

The final alternative considered uses a conduction heating system built around special dishes, in which food is both heated and served, and a special heating module.

The dishes consist of a porcelain ceramic inner dish permanently bonded to a polymer bottom shelf. Metal buttons built into the bottom shelf provide electrical contact when placed on conductor rails in the heating module. Resistors in the inner dish convert the electrical energy to heat. The result is that the covered dish or bowl acts as a minature oven or steamer as it becomes a moist heat environment.

The heating module holds 24 plates or bowls, with a heating time of approximately fourteen minutes for ten ounces of food. There is a direct relationship between the amount of food on the plate and the heating time. For this reason each plate has a built-in temperature control which brings the food to temperature and then maintains the proper service temperature.

This option has no restrictions on tray size or type of delivery vehicle. Only the dishes and oven are provided. A sophisticated cart that will eliminate a considerable amount of food handling is being developed that should be available shortly.

a. **Advantages:**

(1) Twenty-four meals can be reheated together.

(2) Reduced possibility of overheating by providing individual control.

(3) No restrictions on tray or cart configuration.

(4) Late or delayed trays easily accommodated.

(5) Wide menu range can be handled.

b. **Disadvantages:**

(1) Requires special dishware which must be periodically tested.

(2) Requires considerable handling in the galley.

(3) Takes at least twelve minutes to heat one meal.

(4) An expensive leased system.

SYSTEM EFFECTIVENESS MODEL

Methodology

The system effectiveness model used for evaluation and comparison of the alternatives reduces the valuation of the total patient tray delivery system to a series of simple decision problems which can be systematically and objectively analyzed. For each alternative, solutions to the simpler problems are then combined into a characteristic parameter value which is subsequently used to calculate a measure of effectiveness for the system. Finally, a measure of the relative effectiveness of the alternative is determined as the ratio of the measure of effectiveness of the system to that of the baseline or current system.

The proper use of this methodology requires that (1) the problem objectives be clearly defined, (2) the relevant factors which must be considered in meeting the objectives be delineated, (3) the criteria and/or standards to be used in evaluating these factors be established, (4) the relative importance (i.e., weight) of the factors in achieving the desired goal be set, and finally, (5) a specific model be defined to integrate these other considerations into realistic performance indices for the alternatives under consideration.

The resulting model is shown in Figure 2. The five major parameters considered are performance, labor, compatibility, equipment characteristics, and investment cost. Each of these parameters was evaluated by dividing it into a series of effectiveness factors, which were rated on a ten point scale. The values of these effectiveness factors were

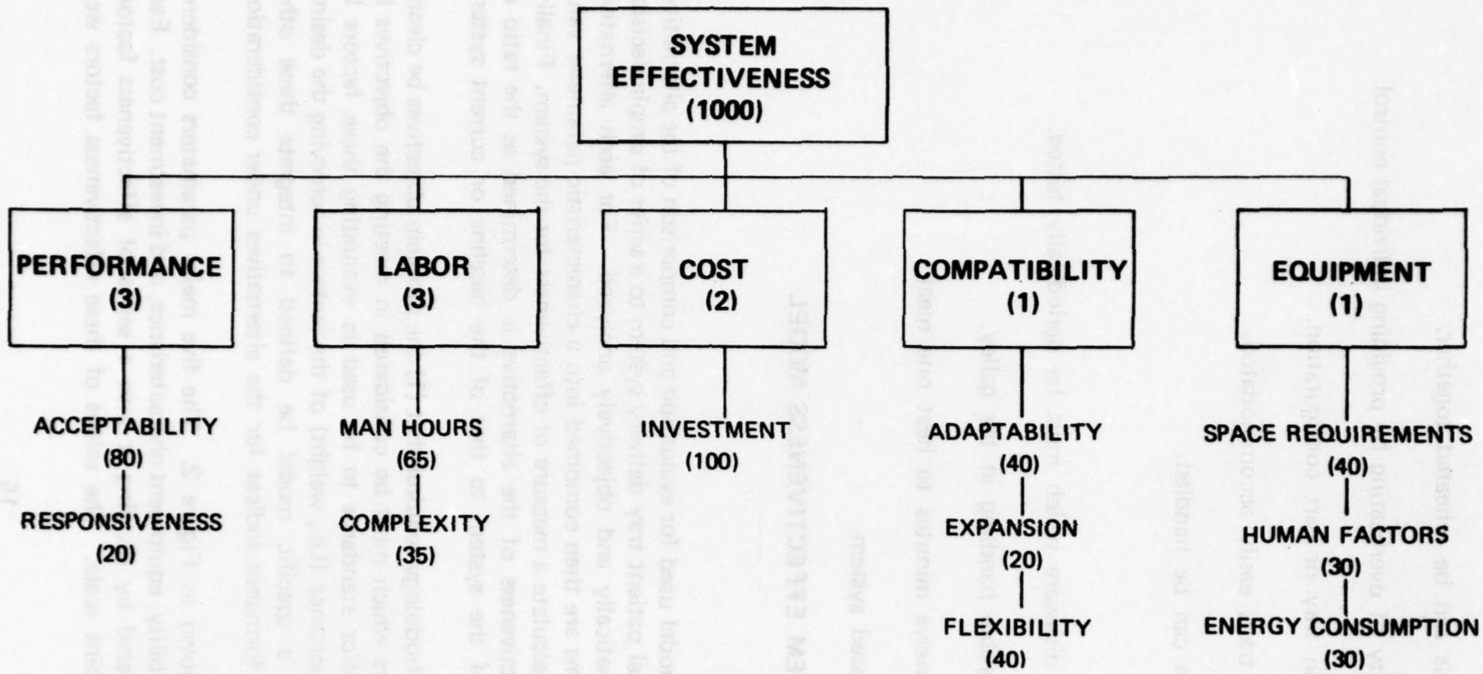
SYSTEM EFFECTIVENESS (1000)
PERFORMANCE (3)
LABOR (3)
COST (2)
COMPATIBILITY (1)
EQUIPMENT (1)
ACCEPTABILITY (80)
RESPONSIVENESS (20)
MAN HOURS (65)
COMPLEXITY (35)
INVESTMENT (100)
ADAPTABILITY (40)
EXPANSION (20)
FLEXIBILITY (40)
SPACE REQUIREMENTS (40)
HUMAN FACTORS (30)
ENERGY CONSUMPTION (30)

FIGURE 2

determined considering each alternative as it would be used in existing food service operations with single-tray assembly. A weight was established for each effectiveness factor between 0.5 and 4.0 in terms of their importance to the effective and economical operation of a patient tray delivery service. Thus, for each alternative, numerical values on a 0 to 10 scale are determined for each effectiveness factor. Then the measure of effectiveness for each characteristic parameter is found by the weighted summation of these performance factors:

$$C_j = \sum_{i=1}^{n} W_{ij} \cdot EF_{ij} \tag{1}$$

where,

C_j = Characteristic Parameter, j = 1,2,...,5

W_{ij} = Weight, i = 1,2,...,n

EF_{ij} = Effectiveness Factor, i = 1,2,...,n

The effectiveness for each alternative is the sum of the values of the individual characteristic parameters, weighting each for its relative importance in meeting the needs and objectives of the hospital food service:

$$E = \sum_{j=1}^{5} V_j \cdot C_j \tag{2}$$

where,

E = System Effectiveness

V_j = Parameter Weight, j = 1,2,...,5

C_j = Characteristic Parameter, j = 1,2,...,5

The weights assigned to the various effectiveness factors (EF_{ji}) and the characteristic parameters (C_j) are based upon our best judgments of the observations in military and civilian hospitals, and upon assessment of the most desirable objectives to be achieved in military food service operations.

Definitions

The definitions of the parameters and effectiveness factors are as follows:

1. **Performance** is the ability to offer hot and or cold foods at prime temperature and quality to patients over a period of time. It is a measure then of how well an alternative maintains the temperature and quality of a patient meal, meal acceptability,

considering both expected and unexpected delays. These may be caused by operational difficulties; e.g., delays in transit, scheduled or unscheduled delays due to the temporary absence of a patient from his bed, and late arrivals.

Responsiveness to patient demand describes the ability of a tray system to provide a palatable meal at a time determined by the patient who might not be hungry or might be absent during the normal service period.

2. **Labor Characteristics** are evaluated as the direct impact of the alternatives on the quantity (man-hours required) and quality (level of skill or training) of the labor used to operate the system. More specifically, this parameter considers the number of different operations necessary for the production of the meals in various functional areas and the specialized training, if any, necessary for the use of the system. This, then, is a proxy for the labor costs needed to operate a system. For the sake of simplicity, these factors are considered by the different task requirements and functional areas.

3. **Compatibility Characteristics** describe the ability of a delivery service (a) to indirectly reduce manpower requirements by allowing assembly during non-peak workload hours and to facilitate use of various operational procedures to reduce manpower in other food service areas, (b) to adapt the physical plant in which the alternative is used, or (c) to increases or decreases in the size of the operation. These factors are called flexibility, adaptibility to current structures, and expansion requirements, respectively.

4. **Equipment Characteristics** are rated by (a) the space requirements of the delivery system equipment in different areas of a hospital on a square footage basis, (b) by human factors of the equipment as defined by size and weight (transportability) and complexity of equipment operation, and (c) by the amount of energy required to operate the tray service.

5. **Equipment Cost** is the initial capitalization cost for the delivery system and additional equipment needed in a conventional kitchen equipped with a tray assembly line (Table 1).

Using these definitions, the effectiveness of each concept can be evaluated, which, when divided by the baseline or current system value, gives a measure of relative effectiveness.

$$\text{Relative Effectiveness} = \frac{\text{Effectiveness of Alternative System}}{\text{Effectiveness of Baseline System}} \qquad (3)$$

TABLE 1

Investment Costs
(200-Bed Facility)

System Components	M–1	M–2	M–3	M–4	M–5
			Alternatives		
Carts (Unit Cost/Units Required)[a]	$220/13	$1150/10	$3250/11	$3250/11	$4928/11
Trays	$40/220	$4.52/220	$4.52/220	$4.52/220	$146/220[b]
Pellet Heater		$1026/2			
Cover Dispenser		$406/4			
Pellet Base		$13.78/220			
Pellet Cover		$5.25/220			
	$11,660	$20,357	$36,744	$36,744	$86,328

[a]Number of items – Found by rounding up number needed for 200-bed facility and adding 10% for backup requirements.

[b]Included in the cost for this system is a one year supply of required disposables.

CONCLUSIONS

Comparison of Alternatives

A summary comparison of the systems, which can be considered for use in existing hospital food service operations, is given in Table 2. All these alternatives are compatible with current operations and would not require major changes in equipment, work force levels, in existing procedures, or in employee skill levels. Except for the heated-tray concept, all exhibit effectiveness values superior to the baseline. The alternatives, ranked in order of decreasing effectiveness, are the insulated tray, unitized pellet, baseline, and heated tray with ratings of 1.18, 1.07, 1.04, 1.00, and 0.91, respectively. The advantage of the insulated-tray concept lies in improvements in labor, equipment, and compatability characteristics. This must be balanced by the requirement that meals **must** be plated on a hot and cold assembly line and served as soon as possible after preparation. Although rated somewhat lower, the unitized pellet system may be advantageous under circumstances where considerable delays in tray delivery are encountered. Again, reductions in labor, especially those achieved in the ward area, are the best feature of this concept.

The insulated tray system can be purchased or leased, and can be used with disposables or china. The initial purchase cost for the system is shown in Table 1. The projected annual cost of insulated-tray equipment under the different financing and dishware choices are shown for different size facilities in Table 3. In this analysis, the total annual cost includes the cost of replacement of the trays, the transport carts, and permanent dinnerware; the cost of disposables and other supplies; and the possible leasing costs. Clearly, the most economical way to implement this concept in any size facility would be to purchase the equipment and permanent dinnerware. A very *significant* savings results from the purchase of the equipment rather than leasing it. Although permanent dinnerware requires the least investment, reductions in operating labor costs by eliminating some portion of the present warewashing staff may be possible by using disposables. In this instance, purchase of the equipment and operating with disposables could be the preferred alternative. This can only be determined by evaluating the specific facility requirements, based on the actual number of meals served, warewash staffing and prevailing wage rages for those personnel. A worksheet for use in comparing these alternatives in specific facilities is presented in Appendix B, Table B–3.

Conclusions

From the results of this analysis, the following conclusions can be drawn about the Patient Tray Delivery System to be used under current operational procedures:

1. On the basis of this model of effectiveness, most of the alternative systems are rated higher than the present method.

2. In hospitals where concurrent hot and cold assembly is possible, the insulated-tray concept would be the preferred alternative.

TABLE 2

System Effectiveness Summary

Characteristic Parameter	Weight	Effectiveness Factor	Weight	M–1	M–2	M–3	M–4	M–5
Performance	(3)	Acceptability	(80)	38	38	47	47	50
		Responsiveness	(20)	0	4	10	10	10
		Subtotal		38	42	57	57	60
Weighted Subtotal				114	126	171	171	180
Labor	(3)	Man Hours	(65)	65	57	43	52	57.5
		Complexity	(35)	29	29.5	27	26	22.5
		Subtotal		94	86.5	70	78	80.0
Weighted Subtotal				282	259.5	210	234	240
Cost	(2)	Investment	(100)	100	90	85	85	30
Weighted Subtotal				200	180	170	170	60
Compatibility	(1)	Adaptability	(40)	40	30	18	18	22
		Expansion	(20)	20	9	4	4	8
		Flexibility	(40)	12	12	16	20	16
		Subtotal		72	51	38	42	46
Weighted Subtotal				72	51	38	42	46
Equipment	(1)	Space Req	(40)	36	31	26	26	28
		Human Factors	(30)	30	24	18	18	16
		Energy Consumption	(30)	30	21	12	12	18
		Subtotal		96	76	56	56	62
Weighted Subtotal				96	76	56	56	62
System Weighted Total				764	692.5	654	673	588
Relative Effectiveness				1.18	1.07	1.00	1.04	0.91

TABLE 3

Annual Costs[a]

Insulated Tray System

			MTF Requirements					
			Units			Annual Cost/Line Item		
Line Item	Capital Cost/ Economic Life	Annual Cost Unit	75	200	500	75	200	500
1 – Cart	$220/7 yr.	$ 45.00	6	13	31	$ 270	$ 585	$ 1395
2 – 25% Tray Replacement	40/4 yr.	13.00	21	55	138	273	715	1794
3 – Meals per Year	–	–	82125	21900	547500	–	–	–
4 – Supplies per Meal[b]	0.015/1 yr.	0.0165	–	–	–	1355	3614	9034
5 – Dishware per Meal[c]	0.007/1 yr.	0.0077	–	–	–	632	1686	4216
6 – Disposables per Meal[d]	0.060/1 yr.	0.0660	–	–	–	5420	14454	36135
7 – Lease per Meal[e]	0.097/1 yr.	0.1067	–	–	–	8763	23367	58418

System	Relevant Line Items	75	200	500
Purchase				
China	1+2+4+5	$ 2530	$ 6600	$16439
Disposables	1+2+6	5963	15754	39324
Lease				
China	4+5+7	10750	28667	71668
Disposables	6+7	14183	37821	94553

[a] Cost based on 100% utilization of capacity (i.e., 200-bed facility serves 200 in-patient trays per meal).

[b] Supplies include plastics and one-time use items such as food wrap.

[c] Dishware replacement cost converted to cost per meal.

[d] Disposables are one-time use dinnerware.

[e] Lease cost includes trays, service and maintenance of systems (i.e., Lessor absorbs equipment depreciation).

3. In hospitals where delivery times of longer than 30 minutes from kitchen to patient and/or split tray assembly is the rule, the unitized pellet appears to be the best heat maintenance method.

The values used in this analysis, shown in detail in Appendix A have been based, where possible, on observation of the systems which are in use, and on thorough study of those not available for operational evaluation. These rankings qualitatively rate the effectiveness of the alternatives to one another, and, thereby, allow a systematic evaluation of the relative performance of the different alternatives available for patient tray delivery.

Recommendations

Based on the results of this analysis of patient tray delivery, in existing Army Medical Treatment Facilities it is recommended that insulated-tray system (M–1) should be used as interim replacement for the hot/cold carts in those facilities employing conventional production methods and hot delivery. In some instances, this may require some revision of the staffing and operational procedures to allow for single-stage tray assembly for maximum efficiency, and purchase of improved steam tables and heated lowerators to insure proper hot food temperatures. However, the system requires a minimum of physical plant changes and of personnel retraining in its adoption, thereby allowing the most rapid implementation of any of the evaluated concepts.

To realize the most significant savings, an insulated tray system should be purchased.* However, the decision to use permanent or disposable dishware with the insulated-tray system must be determined for each particular facility (Appendix B).

*An evaluation of thermal trays for hospital patient feeding was made in FY77 by the Food Engineering Laboratory, US Army Natick Research and Development Command for the Office of The Surgeon General.

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APPENDIX A

Derivation of System Effectiveness Values

System Effectiveness of Alternatives

Characteristic Weighting Value		System Characteristic	Weight	(M–1)		(M–2)		(M–3)		(M–4)		(M–5)	
	I.	Performance											
	a.	Acceptability when Served:											
		1. On Schedule	4	7	28	7	28	8	32	8	32	8	32
		2. W/short hold	2	5	10	5	10	6	12	6	12	7	14
		3. W/extended hold	0.5	0	-	0	-	4	2	4	2	5	2.5
		4. W/scheduled delay	0.5	0	-	0	-	2	1	2	1	3	1.5
		5. To late arrival	1	0	-	0	-	0	-	0	-	0	-
	b.	Responsiveness to Patient Demand	2	0	-	2	4	5	10	5	10	5	10
		Subtotal	10		38		42		57		57		60
3		Weighted Subtotal			114		126		171		171		180

System Effectiveness of Alternatives (Cont'd)

Characteristic Weighting Value	System Characteristic	Weight	(M–1)		(M–2)		(M–3)		(M–4)		(M–5)	
	II. Labor Characteristics											
	a. Man-hours Required For:											
	1. Kitchen Assembly	3	10	30	8	24	7	21	8	24	8	24
	2. Ward Assembly	3	10	30	10	30	7	21	9	27	10	30
	3. Cart Sanitation	0.5	10	5	6	3	2	1	2	1	7	3.5
	b. Complexity of Operation											
	1. Kitchen Assembly	1	4	4	5	5	7	7	6	6	1	1
	2. Heat Maintenance	1	10	10	10	10	9	9	9	9	7	7
	3. Ward Assembly	1	10	10	10	10	7	7	7	7	10	10
	4. Sanitation	0.5	10	5	9	4.5	8	4	8	4	9	4.5
	Subtotal	10		94		86.5		70		78		80
3	Weighted Subtotal			282		259.5		210		234		240

System Effectiveness of Alternatives (Cont'd)

Characteristic Weighting Value	System Characteristic	Weight	(M–1)		(M–2)		(M–3)		(M–4)		(M–5)	
	III. Equipment Cost Characteristics											
	Investment	10	10	100	9	90	8.5	85	8.5	85	3	30
2	Weighted Subtotal			200		180		170		170		60
	IV. Compatability Characteristics											
	a. Adaptability to Current Structures											
	1. Electrical Requirements	2	10	20	8	16	5	10	5	10	7	14
	2. Elevator and Corridor Requirements	2	10	20	7	14	4	8	4	8	4	8
	b. Expansion Requirements											
	1. Off-Site Requirements	1	10	10	5	5	1	1	1	1	3	3
	2. Ward Expansion	1	10	10	4	4	3	3	3	3	5	5
	c. Operational Flexibility	4	3	12	3	12	4	16	5	20	4	16
	Subtotal	10		72		51		38		42		46
1	Weighted Subtotal			72		51		38		42		46

System Effectiveness of Alternatives (Cont'd)

Characteristic Weighting Value	System Characteristic	Weight	(M–1)		(M–2)		(M–3)		(M–4)		(M–5)	
	V. Equipment Characteristics											
	a. Space Requirements											
	1. Ward	3	10	30	9	27	8	24	8	24	8	24
	2. Kitchen	1	6	6	4	4	2	2	2	2	4	4
	b. Human Factors											
	1. Transportability	2	10	20	8	16	4	8	4	8	6	12
	2. Complexity of Equipment	1	10	10	8	8	10	10	10	10	4	4
	c. Energy Consumption	3	10	30	7	21	4	12	4	12	6	18
	Subtotal	10		96		76		56		56		62
1	Weighted Subtotal			96		76		56		56		62
	Weighted System Total			764		692.5		645		673		588

APPENDIX B

The Permanent Versus Disposable Decision

ANALYSIS OF THE COSTS OF USING PERMANENT AND DISPOSABLE DINNERWARE

The cost difference between the use of permanent and disposable dinnerware in a food service facility can be found by calculating the total cost of operating with either concept on an annual basis. This determination involves the calculation and summation of all relevant costs in a context which will allow comparable results. The following worksheet has been prepared to serve as a framework that will facilitate the calculation of these comparable cost projections.

The worksheet is designed to be used to project the costs of operating under each alternative that might be used; i.e., permanent dinnerware, disposable dinnerware, or some combination of the two. The resulting total cost, that is, the sum of the relevant individual cost items under each assumption, can then be compared to determine the most economic advantageous alternative.

Instructions For Specific Worksheet Items

A. Labor

1. Fill in that portion of food service man-hours that it is anticipated will be typically needed each day for dinnerware sanitation and the average hourly rate for the involved workers. The cost per year is the product of these numbers multiplied by 365.

2. Similarly, calculate the labor cost of sanitation of dispensers and other equipment related to permanent dinnerware.

B. Equipment Costs

The annual cost of new equipment necessary for operation under either alternative during the period under consideration must be calculated. Fill in the purchase price of the equipment, such as a dish dispenser or new carts, and multiply by the present value factor appropriate for its economic life. For food service equipment, the economic lifetime is ten years, which has a present value factor is 0.1655.* The product of these terms summed for all equipment is the annualized equipment cost.

C. Operating Costs

For these expenses use the most current year's costs. The usage factor provides a method to adjust these current values to the anticipated cost for the use of permanent

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*Army Regulation No. 11–28, *"Economic Analysis and Program Evaluation For Resource Management,"* HQ, Dept of the Army, December 1975.

ware under the different operating assumptions. If the level of use of a permanent ware item is expected to remain the same, the usage factor will be 1.0. If use of disposables reduces this, for example, to twenty percent, the factor will be 0.20. The cost of utilities may be included. Utility costs are often difficult to determine, in which case $0.04 may be used as the approximate cost for sanitizing a complete set of permanent dinnerware. Fewer permanent ware items would make this expense proportionately less, and again this would be adjusted by a usage factor of less than 1.0.

D. Cost of Disposable Ware

For each disposable item to be used, its cost is multiplied by usage rate (i.e., the number of times the item is used on an average tray) are multiplied to give the item cost per meal. The sum of these item costs will give the typical disposable cost per meal. The total yearly cost can be determined by multiplying the cost of disposables per meal by the anticipated number of meals that will be served on disposables during the year.

If typical cost or usage factors are not known for the specific items, values derived from data from hospitals which are currently using disposables are given in Table B–1, and can be used for this purpose.

E. Cost Of Removal

The cost of garbage removal for a hospital using totally disposable dinnerware averages $0.03 per meal. If this cost is relevant, an annual cost can be calculated from this value multiplied by the number of meals served annually, adjusted for the proportion of disposable items that it is anticipated will actually be used. Otherwise, the actual costs of garbage removal related to food service can be obtained from the facility engineers, and these costs multiplied by the volume of that garbage and waste produced by disposable dinnerware usage (i.e., utilization factor). To provide a basis for these costs, values have been obtained for a typical facility using no permanent ware, Table B–2. Estimates of values for other facilities can be made by multiplying these values by the proportionate bulk of the disposable dinnerware that is projected for use during the period under consideration for applicable expenses.

Table B-1

Cost and Usage Factors for Disposable Dinnerware

Item	1977 Cost/Item	Typical Hospital Meal Usage
Entree Dish	0.031	1.0
Side Dish	0.016	1.5
Soup Dish & Lid	0.022	0.3
Cup & Lid	0.020	1.0
Coffee Lid	0.009	1.0
Utensils	0.361	1.0

Table B-2

Waste Removal Costs

Item	Individual Cost	Cost/Meal	Usage/100 Meals
Fixed Annual Charge	-	$0.82	-
Bags	$0.15	0.009	6
Disposal Cost/Ton	6.00	0.00048	-

Table B-3

Worksheet

Permanent Ware_____% Disposable Ware_____%

A. Labor	**Total Hr/Day**	**Rate/Hr**	**Item Cost/Yr**	**Total Annual Cost**
1. Sanitation of Dinnerware				
2. Sanitation of Dispensers, etc.				
Total Cost				________
B. Equipment Costs	**Purchase Price**	**P.V. Factor**	**Item Cost/Yr**	
1. Dispensers				
2. Other Equipment				
Total Cost				________
C. Operating Costs	**Current Yr Costs**	**Usage Factor**	**Item Cost/Yr**	
1. Replacement of Dishware				
2. Replacement of Utensils				
3. Supplies (Detergents, Rinse, etc.)				
4. Utility Costs (Electricity and Hot Water for Washing)				
Total Cost				________

D. Cost of Disposable Ware	Cost/ Item	Usage Factor	Cost/ Meal	Meals/ Yr	Item Cost/ Yr	Total Annual Cost
1. Entree Dish						
2. Side Dish						
3. Soup Dish and Lid						
4. Cup and Lid						
5. Coffee Lid						
6. Utensils						
Total Cost						
E. Disposable Removal Cost						
1. Dinnerware, Disposable			$0.03			
2. Fixed Annual Charge						
3. Bags						
4. Pick-Up Cost						
5. Compactor of Dumpster Fee						
6. Cost/Ton						
Total Cost						
Total Cost of System						